
Mechanical Systems Engineering for Optical Payloads

**MIT Dept. of Aeronautics and Astronautics
16.851 Satellite Engineering**

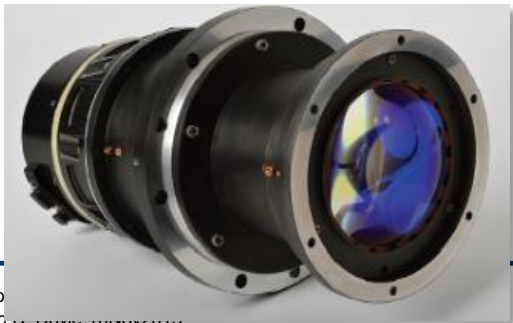
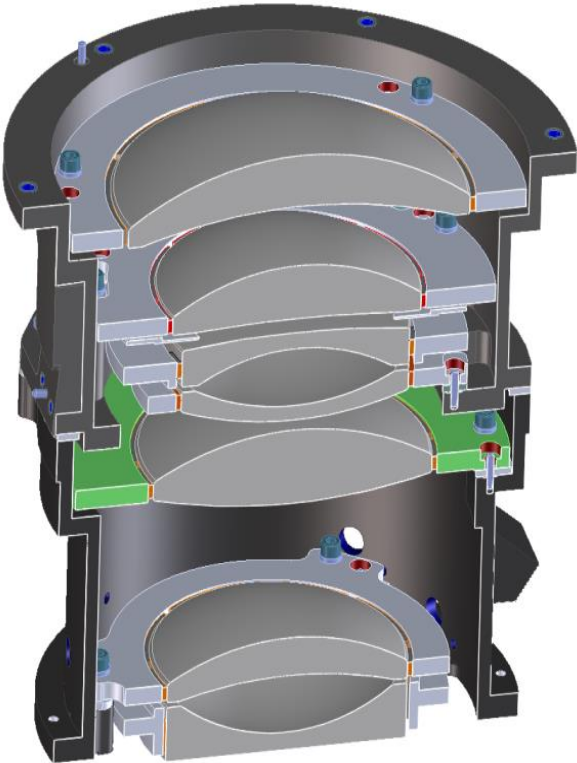
**Dr. Keith B. Doyle, MIT Lincoln Laboratory
10 November 2015**



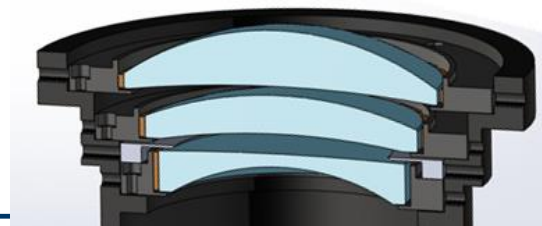
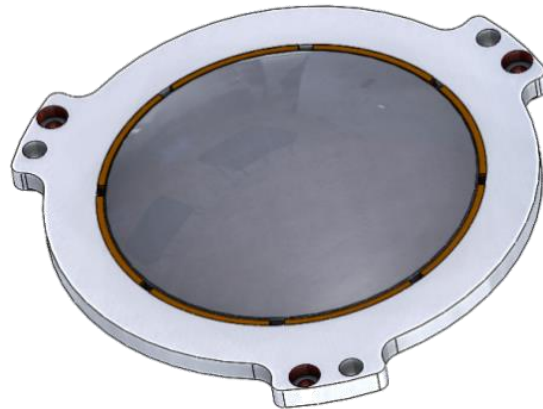
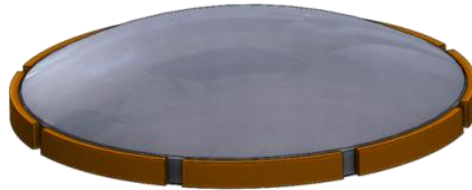


TESS Optical Mounting

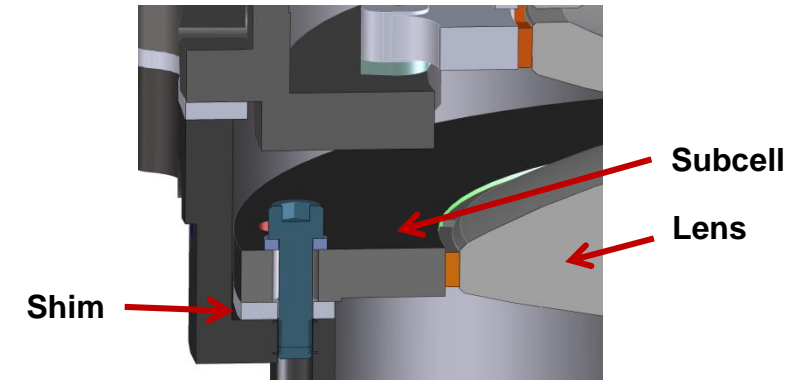
TESS Lens Assembly



Optics Mounted in Subcells using Segmented RTV Pads



Subcell alignment controlled with shims for 5-DOF control



Camera Housing Mounted with Flexures

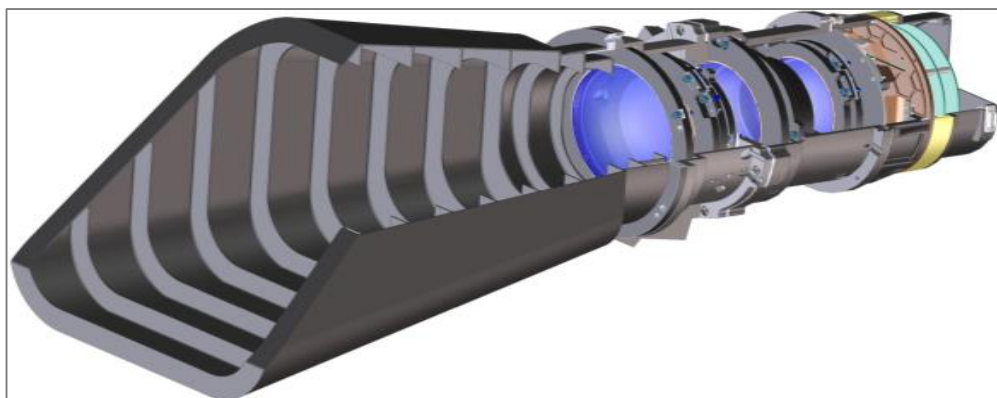




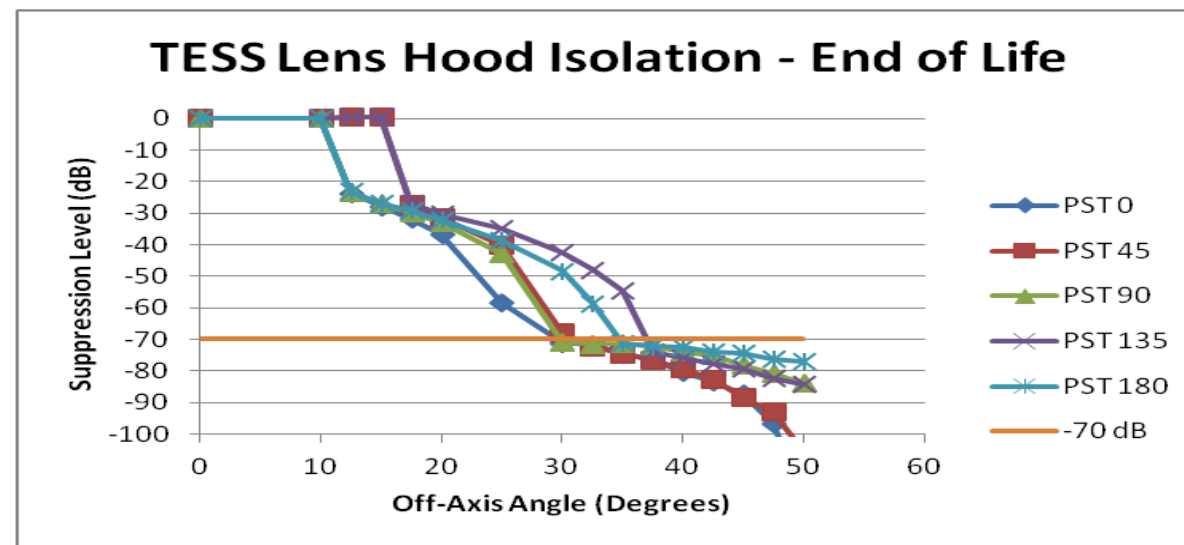
Stray Light and Baffles

TESS Program

- Lens hood design blocks Earth- and moonshine from reaching the detector plane
 - Two lens hood lengths (required by spacecraft keep-out volume)
- Lens hood model
 - Z302 black paint in lens barrel
 - IEST-STD-CC1246D level 500A contamination specified on external surfaces
- Baffle achieves 70 dB isolation at 37° range for corner fields

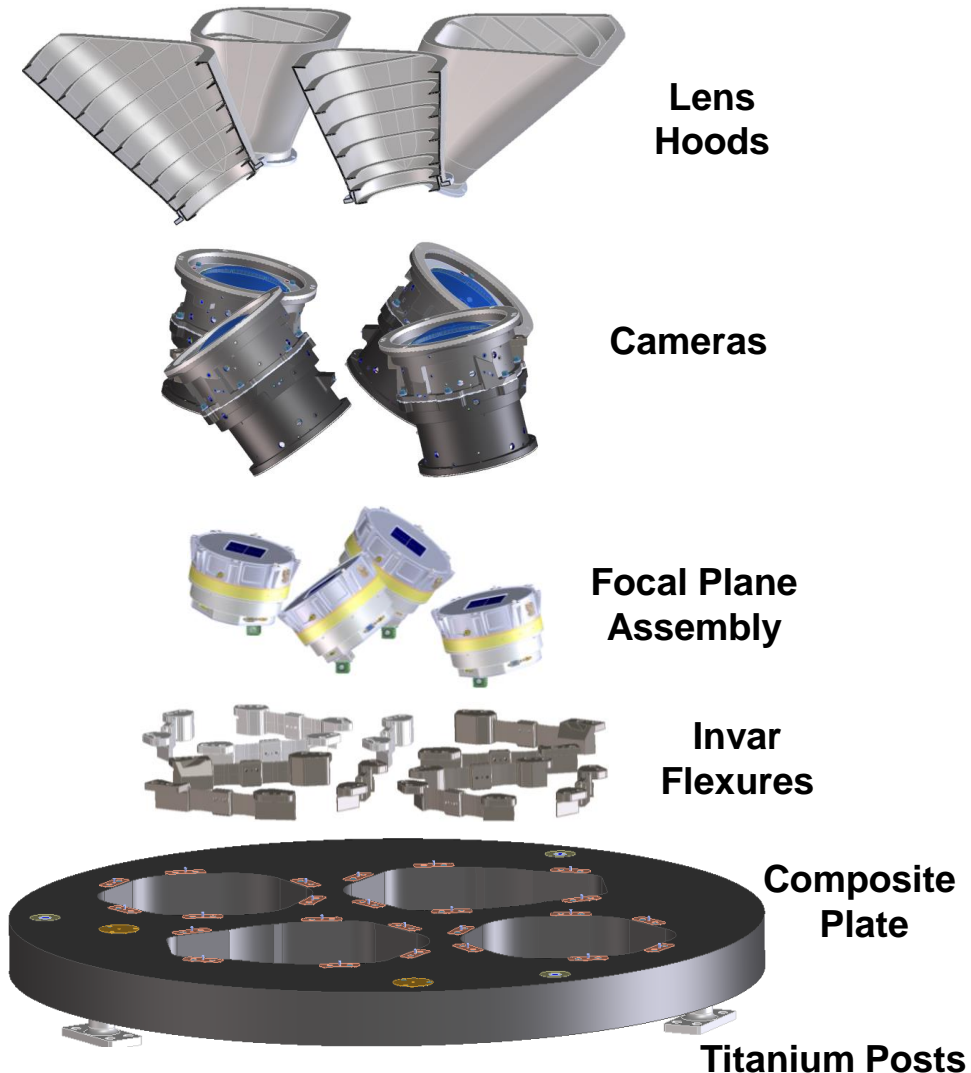


Long Lens Hood





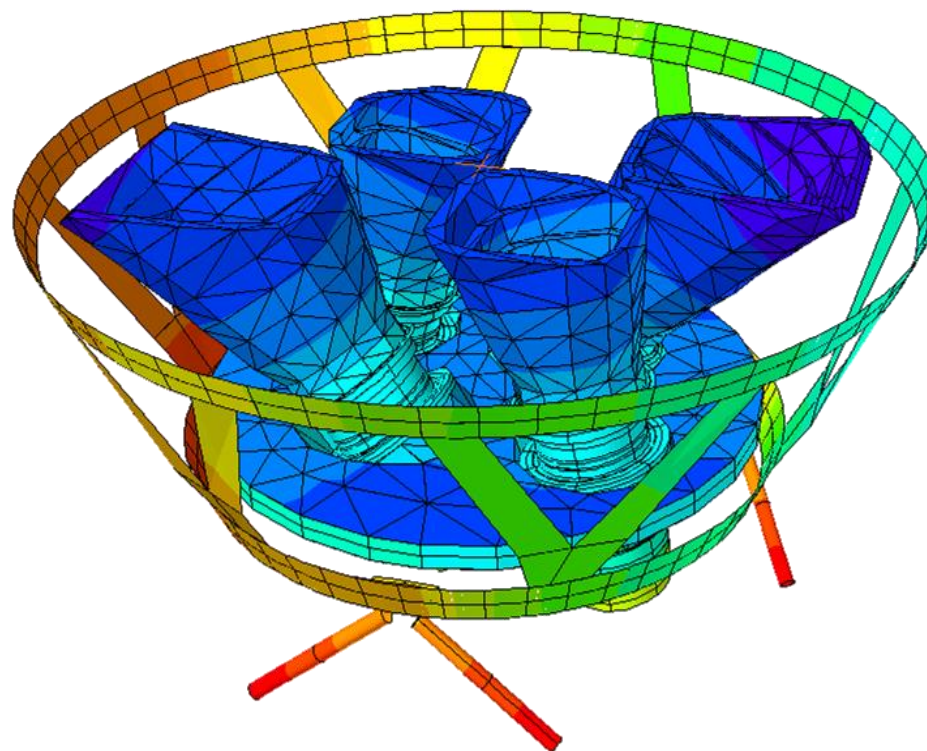
TESS Cameras Thermal Management



- Cameras are passively cooled and cold biased below the nominal operating temperature of -75°C
 - Offset heaters on lens barrel can be used to warm lens assemblies if necessary
- Lens hoods act as radiators
 - Black inside, white outside for high power cases, wrapped with MLI for low power cases
- Camera plate is covered with MLI on bottom side
 - Top white painted for high power cases, covered with MLI in low power cases
- Lens barrels and FPE housings are wrapped with MLI
- Titanium mounts and MLI limit heat transfer from spacecraft
- Sunshade shields cameras from Sun
- Survival heaters on focal plane electronics



TESS Thermal Modeling

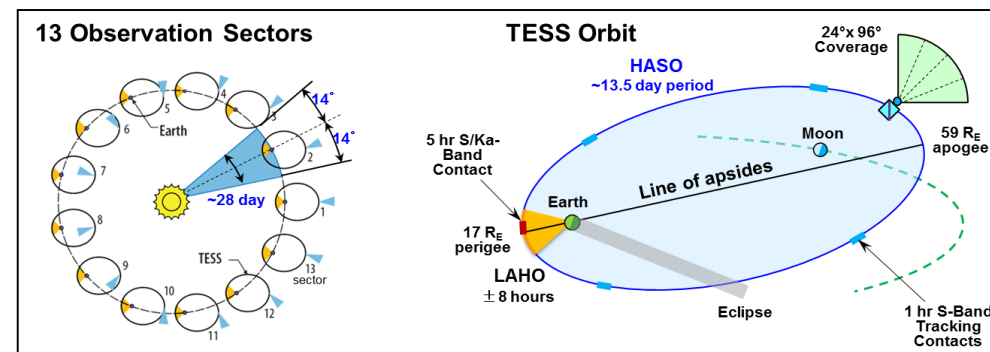




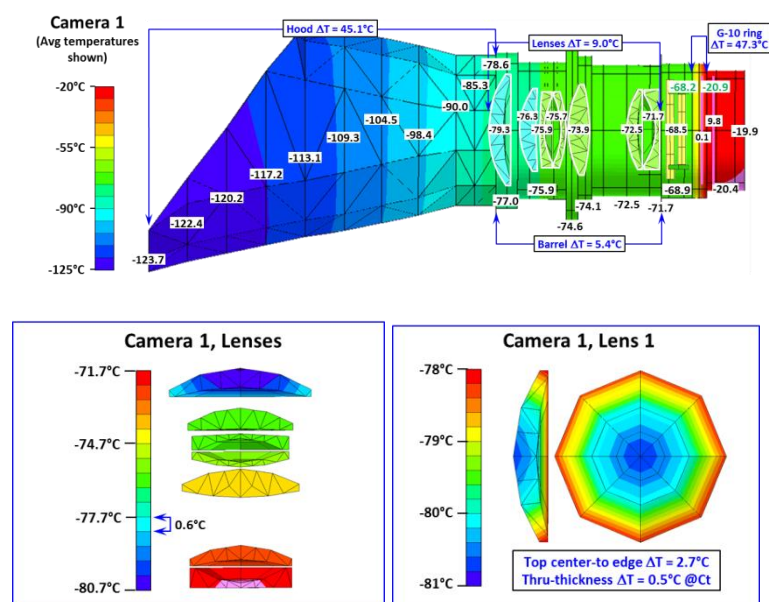
TESS Integrated Modeling and Analysis

Internally developed integrated modeling software used to predict driving performance metrics over TESS orbit

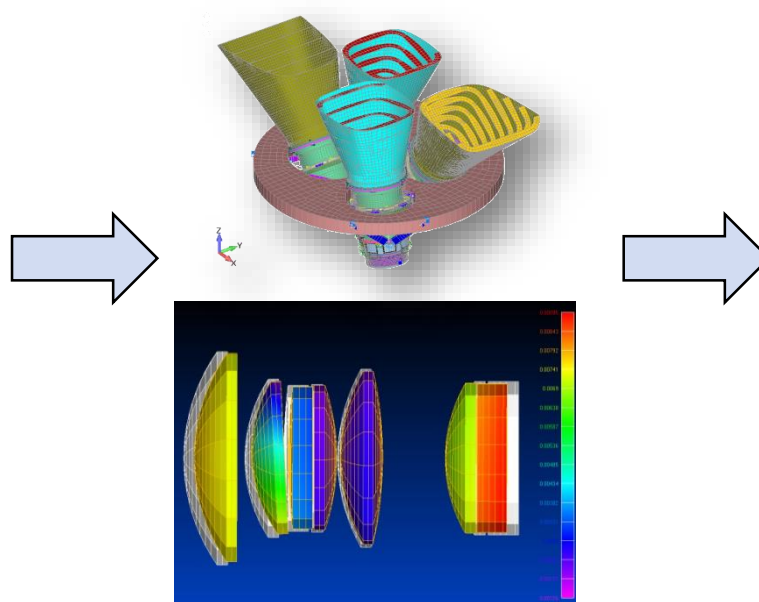
- Optical point spread function
- Pointing errors for each of the four cameras



Temperature Snapshot at Single Point in Time



Thermo-Elastic Response



Optical Performance

